

**more to
explore**



caves, wetlands, streams and glades

more to explore...

cave ecosystem



Caves are dark and mysterious ecosystems. Caves are openings in the earth formed by underground waters. The cave-forming process takes thousands of years and continues today. Caves could have many miles of passageways or extend just a few feet underground. Missouri has so many caves it has been called The Cave State.

Common features of most true caves include an average temperature of 12.7–14.4 degrees Celsius (55–58 degrees Fahrenheit) all year, total darkness and no producers in the form of green plants.

cave entrances

plants and animals

Walking fern and mosses are green plants that can grow in cool, low-light places where there is some sunlight. They are often found around cave entrances. Eastern phoebes are birds that often build nests in the entrance zone of caves, and vultures often use cave entrances to raise their chicks. Snakes use entrance areas to cool down on hot summer days and to hibernate through the cold winter months. Spiders can be found near cave entrances, and daddy longlegs cluster in dark, moist places near the entrance but leave the cave at night to feed on decaying plants and animals. Small insects

Big brown bats sounds vary from long, drawn-out, deep, raspy notes to quick, separate squeaks and clicks that can be heard by humans. Bats communicate with each other by chattering, and young bats squeak to call their mothers. Big brown bats also use ultrasonic cries while flying which help them avoid objects and hunt and chase prey. These sounds cannot be heard by humans.

and tiny decomposers break down leaf litter, small logs, sticks and other bits of organisms that have blown or floated into the cave.

cave twilight zones

plants and animals

The twilight zone is beyond the cave entrance and is usually not long. Turns in the cave passageway eventually block all light coming from the entrance. Once all light is blocked, the passageway leads into the zone of total darkness. Few green plants can live in the twilight zone, and none could survive any deeper in a cave. Certain toads, frogs and salamanders as well as cave crickets and wood rats can be found in and often just beyond the twilight zone. Many of these leave the cave to feed or mate, and some only use the cave during certain seasons.

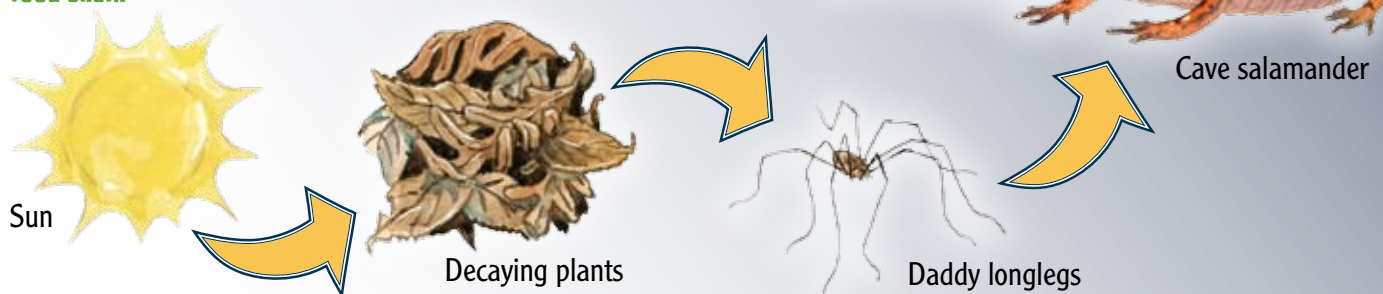


A cave salamander will wave its tail in an effort to distract a predator's attention away from its head.

What could possibly survive in total darkness when energy for organisms in ecosystems begins with the sun and producers?

An entire cave is not in total darkness. Many small bits of sun-loving animals and plants may be washed or blown into a cave.

cave entrance or twilight zone food chain



cave dark zone

plants and animals and specialized structures

Cave areas in total darkness are called the dark zones. Few animals live their entire lives in these deepest, darkest cave zones. Animals that do live in the total darkness of caves have specialized structures to help them survive. Cavefish, grotto salamanders, and cave crayfish live in total darkness and have no need for eyesight or coloration in their skin or exoskeleton to protect them from sunlight. Ozark cavefish and southern cavefish have no color in their skin and are the only Missouri fish without eyes. Their bodies use energy very slowly, which allows them to go long periods of time without food. The pinkish-white grotto salamander adults have eyes that are tiny, partly or completely blind, and covered with a filmy skin. Cave crayfish have longer legs and antennae than non-cave dwelling crayfish. They also are completely blind or even eye-less. However, cave crayfish, cavefish and grotto salamanders have sensory structures, other than eyes, that help them find food.

Bats are the organisms most often connected with caves. Many bats spend most of their time roosting in forests, barns and other types of buildings, but some are more likely to use caves as roosting places either alone or in huge, tight clusters with hundreds of other bats. Some species use caves only during the summer. Others use caves only in the winter to hibernate. Some use caves all year. All bats are cave visitors and, unless they are hibernating through the winter, will leave the cave at night to search for food.

Without sunlight and green plants to begin food chains, deep cave-dwelling animals such as cavefish, cave crayfish and grotto salamander depend on food sources brought into caves by seasonal floods, bats or other cave-visiting organisms. Bat scat, called guano, provides nutrients for bacteria, fungi and the small animals that feed on those decomposers. Decaying leaves and twigs blowing in through cave entrances or washing in through cracks in cave ceilings also provide nutrients and small organisms for food.

cave dark zone food chain

Sun → decaying plants (washed into the cave) → small insects → small cave crayfish → cavefish

humans and caves

Caves are fragile ecosystems, and what happens on the land's surface affects the cave life below. Run-off from pesticides, fertilizer and pollution finds its way easily into cave systems. Humans often break off and destroy delicate cave formations or disturb hibernating bats or bat nurseries in caves. Smoking and littering harm cave ecosystems.

However, humans have taken steps to protect caves, cave animals and the water quality of cave streams by putting up locks, gates and doors on several protected caves and by passing laws against trespassers and those creating problems with water pollution in caves.

When the tip of a walking fern **frond** touches moist soil, a new fern grows making it seem as if the fern is walking across the ground.



Grotto salamanders begin their lives in upland springs and streams, but spend their adult life in the darkness of caves.



more to explore... wetland ecosystem



A wetland is an ecosystem where water makes all the difference. Water controls the environment and all the plant and animal life in it. Wetlands are bodies of shallow, standing water that stay wet for at least part of the year. Swamps, bogs, marshes and fens are examples of wetlands. Water, special soil and water-loving plants are the necessary features of wetlands.

plants and animals

Wetlands are some of the richest ecosystems in Missouri. Many plants and animals, including rare and endangered species, live in and depend on healthy wetlands. Water-loving wetland trees include black willow, bald cypress and tupelo. Cattail, arrowhead, buttonbush, blue flag and duckweed are plants found in

Missouri wetlands. Animals that use wetlands for the food, water, shelter and space they need to survive include



How is a wetland like a restaurant and motel?
Migrating waterfowl use them to rest and to find food.



Bald eagles are often found near wetlands. In 2008, they were removed from Missouri's list of endangered species.

Mallard ducks are omnivores and eat a wide variety of foods, including plants, insects, worms, snails and crayfish. Humans, raccoons, coyotes and owls are some of the predators that eat mallards.

muskrats, beaver and raccoons; bald eagles, red-winged blackbirds and many kinds of ducks; turtles and snakes; green sunfish and bullhead catfish; mussels, snails and crayfish; dragonflies, whirligig beetles and predacious diving bugs. Some animals live in a wetland all year; others visit wetlands throughout the year.

Decomposers play an important role in wetlands by breaking down dead plants and animals into a rich, spongy soil. This rich wetland soil acts like a sponge soaking up and storing water. It protects against flooding during rainy weather by soaking up the water and then slowly releasing it into rivers and streams. Wetland plants and wetland soil filter out pollutants as water slowly passes through them.

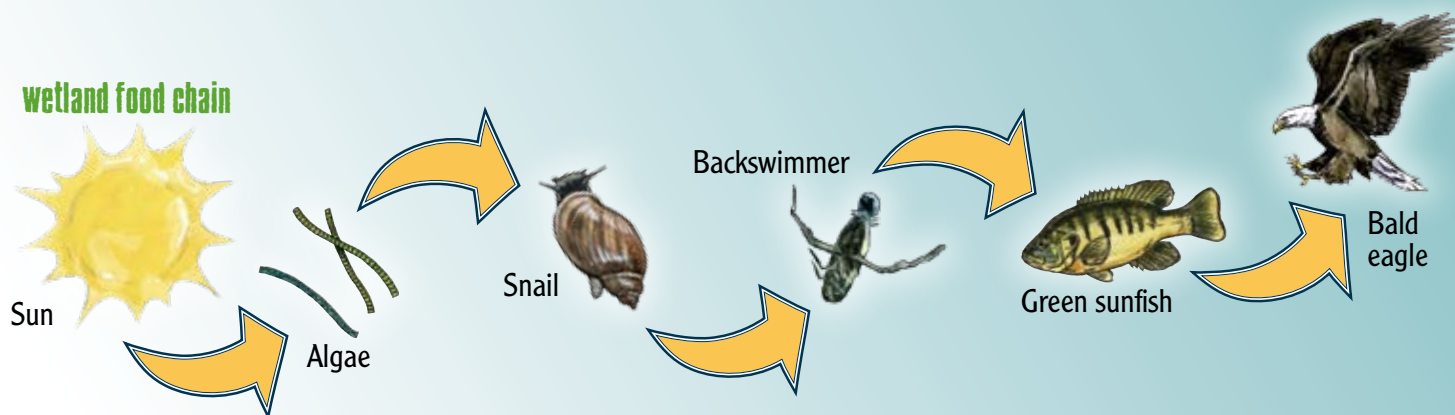
specialized structures

Wetland plants have specialized structures that help them absorb oxygen even in dark, murky water. Many wetland plants have wide trunks or big roots near the water's surface to help them absorb oxygen from the air, and their large leaves take in energy from the sun. Cattails, arrowheads and buttonbush grow tall and grow above other plants to reach sunlight.



Northern water snakes may move onto land but never go far from water.

wetland food chain



Wetland animals have their own specialized structures. Whirligig beetles have special mouthparts for chewing organisms or debris they find on the surface of the water. Bald eagles have sharp talons and sharp, curved beaks for grasping and tearing fish, water birds and dead animals. Least bittern have long legs and long, spread out toes like great blue herons. These specialized structures keep them from sinking into the soft, spongy mud. Least bittern also have feather colors that camouflage them among the tall wetland grasses. Northern water snakes are camouflaged by the spots and bands of color of their scales.

humans and wetlands

Native Americans hunted the great flocks of ducks and geese that migrated through wetlands. They cut and wove cattails into mats, baskets and other items for their homes. Wetland muskrat, beaver and river otter were trapped for their fur and used by Native Americans for clothing and for trade items. Native Americans were careful not to overharvest wetland plants and animals. Their careful interaction with other organisms in the wetland ecosystem kept the ecosystem healthy and balanced.

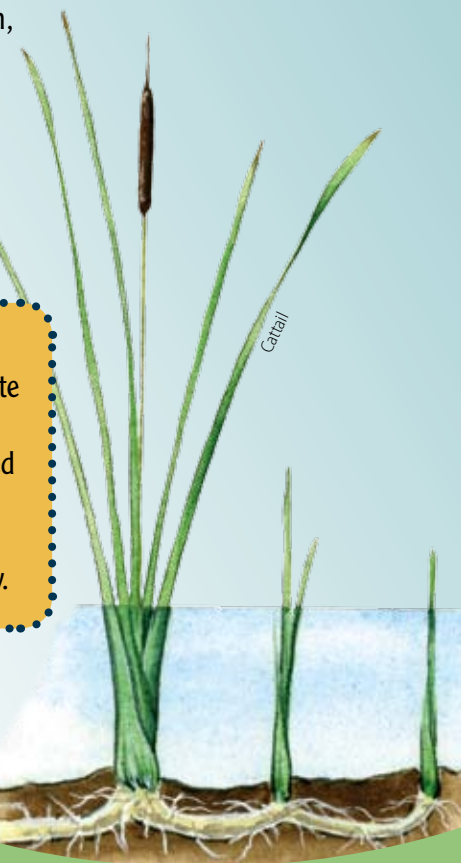
Today, some people drain wetlands because they think wetlands are wasted land or land that could be put to better use as farmland or for highways and housing. When wetlands are drained, all the organisms that depended on them lose what they needed to survive.

However, many people today understand that wetlands are more than homes for plants and wildlife. They know that wetlands filter pollutants and waste from the water, help control flood waters and are the most productive ecosystems in the world. Hunters, birdwatchers, anglers, hikers and many others enjoy wetlands. They see how rich, beautiful and important balanced wetlands are and work to protect them.

Cattails use air and mud to reproduce. Their small fluffy, white seeds blow away in the wind while their root-like stems (called **rhizomes**) grow along just beneath the mud and send up new cattail plants along the way.



Male red-winged blackbirds fiercely defend their wetland nesting territory during the breeding season. They will even attack much larger animals, including horses and people.



Whirligig beetles normally live on the surface of the water and swim rapidly in circles when disturbed.

more to explore...

stream ecosystem



Green heron

A stream is a body of flowing water like a brook or small river. Missouri streams do not all look the same. They differ in size, shape and length. They differ in how fast or slow they flow and in the quality of the water. A single stream ecosystem can be home to thousands of different plants and animals.

Streams share some characteristics. The largest amount of a stream's water flows in the channel. Channels change when streams flood and more water flows through. Riffles are bubbly sections of shallow streams where water flows swiftly over rocks. The rocks provide nooks and crannies for aquatic insects to hide and find food. The riffle bubbles add oxygen to the water.

Streams also have areas of deeper, slower, calmer water called pools. Pools may form behind boulders and large, twisted roots of fallen trees. Pools provide fish with shelter, food and a place to rest.

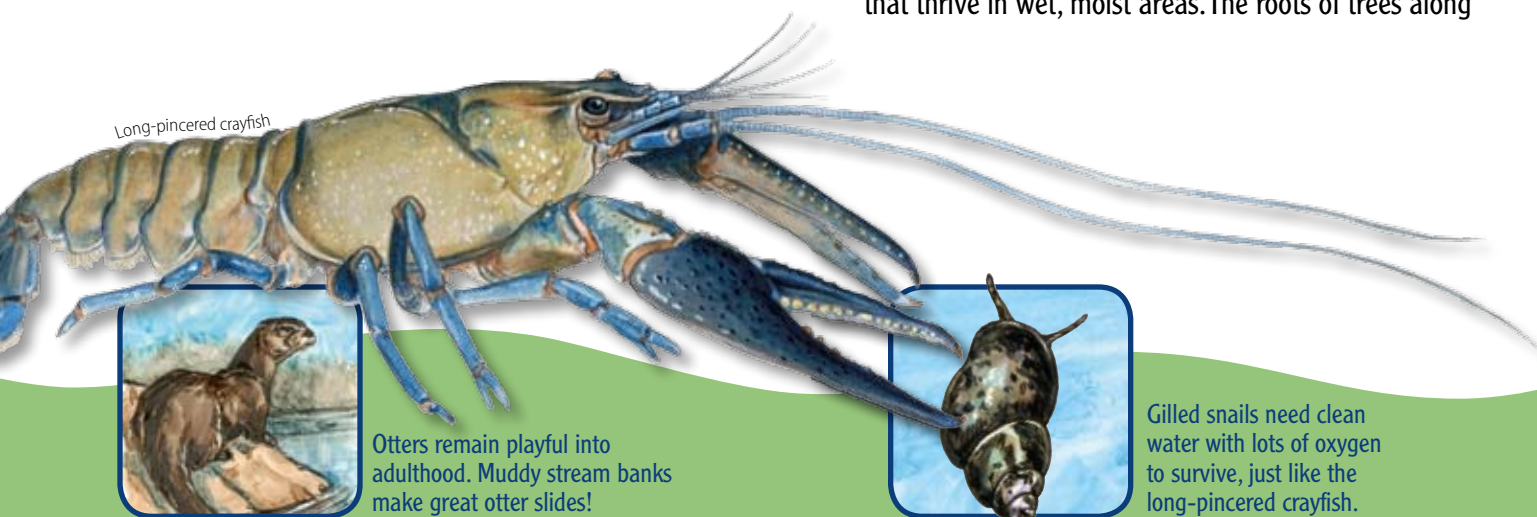
Flood plains are areas on either side of streams that hold flood water. The riparian zones are wide sections of trees, shrubs and other plants that grow along streams. The roots of these plants help keep soils and chemicals

Green heron mainly eat small fish and frogs. They are one of the few tool-using birds and will drop insects, earthworms, twigs or feathers onto the surface of the water and grab the small fish that are attracted by this bait.

from washing into the streams. The health of a stream depends on the makeup of the watershed. A watershed includes all the land that brings rainwater to a stream.

plants and animals

Where a stream is shallow enough for sunlight to reach the bottom, algae is able to grow and provide food for herbivores such as bullfrog tadpoles and gilled snails living in the stream. Plants that grow in and along streams, such as cattails, blue flag and river bullrushes, have long, thin, flexible stems that move easily with the stream current but have roots strong enough to hold them in place. Healthy streams are usually lined with trees such as black willow, sycamore and cottonwood that thrive in wet, moist areas. The roots of trees along

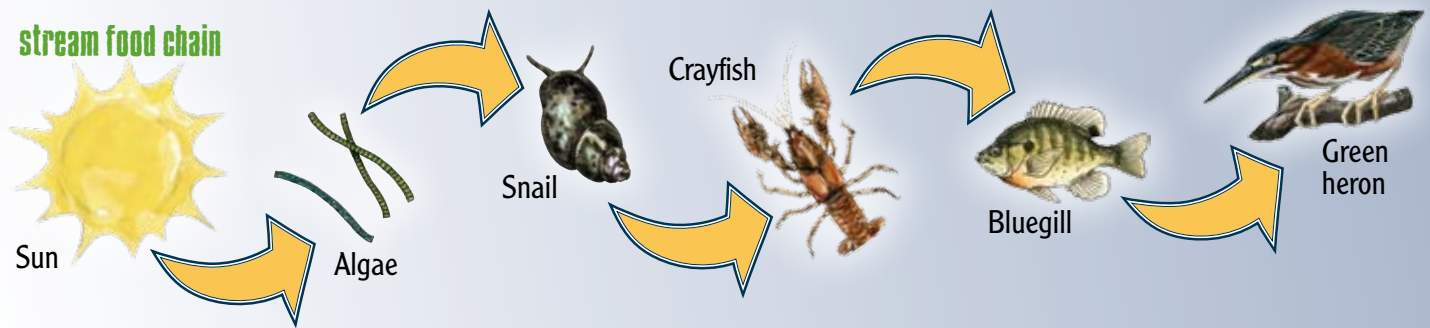


Long-pincer crayfish

Otters remain playful into adulthood. Muddy stream banks make great otter slides!

Gilled snails need clean water with lots of oxygen to survive, just like the long-pincer crayfish.

stream food chain



streams hold the soil of the stream bank in place. The roots and the rest of the tree parts provide shelter and food for many different stream ecosystem organisms.

Turtles, tadpoles, frogs, hellbenders, fish, crayfish, snails and aquatic insects live in different stream areas. Snakes, raccoon and deer are frequent stream visitors seeking water or food. River otter have dens along stream banks but spend much of their time in the water hunting and chasing their food. Their streamlined bodies; webbed feet; long, tapering tails; ears and noses that close when underwater; and eyes near the top of their head are specialized structures that make them more comfortable and graceful in the water than on land.

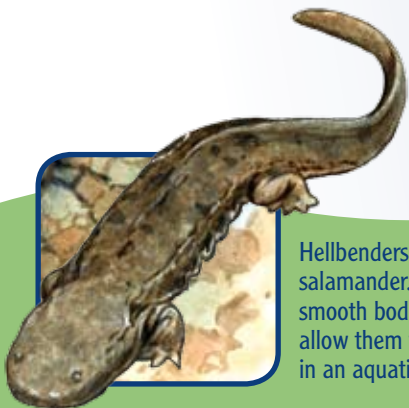
specialized structures

Other specialized structures that help animals survive in a stream ecosystem include the long, thin legs of green heron used for wading and the webbed feet of wood ducks and river otter for swimming. Snails have broad, flat foot-like parts that help them stick to rocks. Freshwater mussels and clams filter tiny food particles out of water drawn in through one of their two tube-like structures and out the other.

humans and streams

Humans harm streams by allowing pesticides, fertilizer and litter to wash off fields and roads and enter streams. Can you guess what the number one form of water pollution is? It's soil! When trees and other plants of riparian zones are reduced or removed, there is nothing left to stop soil from falling from the edges of streams. Humans also affect streams and stream organisms when they dig up gravel from stream bottoms.

People enjoy fishing, canoeing, birdwatching and swimming on Missouri's streams. People often bring along trash bags in case they find litter while playing in a stream. Many people help keep Missouri stream ecosystems healthy by joining Stream Teams. Stream Teams pick up stream litter and collect data on the organisms that live and grow in and around streams.



Hellbenders are Missouri's largest salamander. Their flat heads and long, smooth bodies are structures that allow them to survive comfortably in an aquatic ecosystem.



An orangethroat darter's smaller-than-normal swim bladder holds less air and allows the darter to sink and hover easily near the bottom of a stream.

more to explore...

glade ecosystem



Glades are dry, hot and sunny and formed where layers of rock cut through the soil. Glades usually are small, rocky openings on hills in forests, woodlands and prairies. They are rare, delicate, desert-like ecosystems found in Missouri.

plants and their specialized structures

Glade coneflowers, bladderpod and bottlebrush blazing star are only found in glade ecosystems. Other plants that are able to grow on glades include prickly pear cactus, prairie dock, black-eyed Susan, lichens and mosses.

Lichens are a combination of a fungus and algae. The fungus provides water and nutrients, and the algae is a producer that uses energy from the sun to make food for both the algae and the fungus.

Glade plants have specialized structures that allow them to survive in such a desert-like environment. Many glade plants have seeds that stay dormant and won't sprout and grow for many years until the right amount of soil and water becomes available. Prickly pear cactus stores water in its thick leaves and uses that water during dry periods. Its fruit is red, bristly, shaped like a pear, and can be eaten. Prairie dock has long roots that wind through cracks in rocks seeking water deep down in the ground.

If caught in an open area, eastern collared lizards will often run very quickly on their hind legs with the forward part of their body held upright to escape. They eat a variety of insects such as grasshoppers, beetles and moths as well as spiders, small snakes and other lizards.

animals and their specialized structures

Glade animals have specialized structures, too. Tarantulas are Missouri's largest spiders. These carnivores defend themselves by biting and injecting venom and by releasing irritating hairs into the eyes of predators. Collared lizards prey on spiders, insects, small snakes and other lizards, and when threatened, collared lizards escape by running upright on their hind legs. Special lines camouflage the striped scorpion, and markings and colors on lichen grasshoppers help them blend into the lichen-covered glade rocks. Greater roadrunners can fly but usually use their strong legs to chase their prey. They hold their head and tail flat and parallel to the ground when running at top speed. Roadrunners eat many venomous prey items, including scorpions, spiders and rattlesnakes as well as non-venomous insects, small reptiles, rodents and small birds.

Glade plants use the sun's energy to make their own food. They use the soil to get nutrients. Glade rocks are important non-living things in a glade. They provide

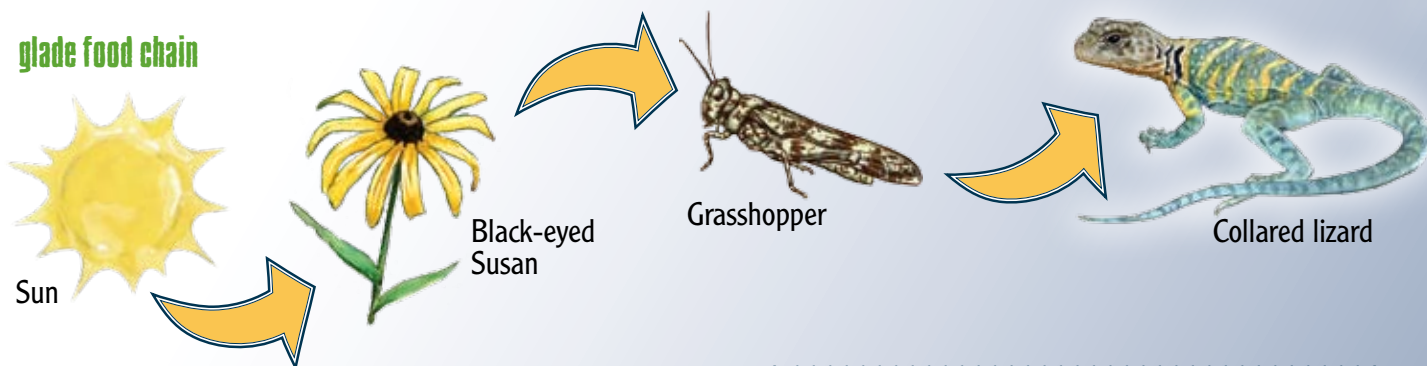


Cactus do grow in Missouri—prickly pear cactus! Watch out for its sharp spines and bristles.



A striped scorpion uses the sharp stinger at the end of its tail to inject venom into its prey. The sting is painful, but not usually dangerous to humans.

glade food chain



shelter from heat and predators. Tarantulas hunt for insects at night but hide during the day in rocky crevices. Collard lizards warm themselves on the glade's flat rocks and crawl under them to hide and to cool off. Striped scorpions are nocturnal carnivores and spend the night hunting spiders, crickets, beetles and sometimes even small mice and lizards.

humans and glades

Glade ecosystems are easily disturbed. Plants that survive in thin, dry soil are sensitive and easily trampled and crushed by careless hikers, horseback riders, mountain bikers and ATV riders. People who remove glade rocks reduce the amount of shelter for glade animals from heat and predators.

People who study and enjoy these special and delicate glade ecosystems know that fire is a vital non-living part of healthy glades. Cedar trees block sunlight from glade plants. Fire burns off cedar trees and other non-glade plants and keeps the area open to sunlight and heat. Glade plants may be burned during a fire, but they grow back quickly and stronger. People manage and protect glade ecosystems by burning and cutting cedars. Left unburned, glades, like prairies, eventually become woodlands and forests.

Common nighthawks feed mostly at dusk and dawn on flying insects. They are drawn to wide open areas such as glades but are often seen in cities and towns catching insects attracted to parking lot lights at night. Bristles surrounding the nighthawk's enormous mouth are specialized structures that allow it to capture insects while it flies. Its lower jaw is shaped in such a way that a nighthawk can drink while it flies, skimming the water surface.

Nighthawks migrate to South America for the winter. On early summer evenings when you hear their *peent* call, look up and try to catch a glimpse of the white bars on their long, bent wings and their darting, acrobatic hunting flight.



Nighthawk



Greater roadrunners can reach running speeds of over 18 miles per hour.



Lichens can grow on bare rock and in harsh environments. Two species of lichen were sent up in a rocket and exposed to the vacuum of space. They returned to earth completely unharmed!